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Trade Reform and the Poor in Morocco: A Rural-Urban General Equilibrium Analysis of Reduced Protection

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ABSTRACT

Morocco is currently about to start reducing industrial protection in the context of its association agreement with the European Union. However, agriculture, which represents the major income source for the disfavored rural population, is the sector that is most strongly protected. In this study, a general equilibrium model of Morocco is used as a laboratory for analyzing the short-run equilibrium effects of alternative scenarios for reduced protection for agriculture and industry. The model, which is calibrated to a Social Accounting Matrix for 1994, is distinguished by an explicit separation of activities, factors, and households into rural and urban. It has a detailed treatment of agricultural and other rural production, the labor market, and households (disaggregated into four types: rural poor, rural non-poor, urban poor, urban non-poor). The simulation results indicate that reduced agricultural protection would generate significant aggregate welfare gains at the same time a significant part of the disadvantaged rural population would lose strongly. The impact of industrial tariff cuts is small. The outcome is less unfavorable for rural households over a slightly longer time frame where labor migration between agriculture, the rest of the rural economy and urban areas is feasible. The results for simulations that introduce compensatory measures targeting the rural population suggest that the dilemma presented by the tradeoff between aggregate and rural welfare can be overcome: in simulations introducing trade liberalization together with government transfers to owners of rainfed agricultural resources, or moderate improvements in rural skill levels or productivity in rural non-agriculture, the gains from trade liberalization are shared relatively evenly among all household groups.

Table of Contents

1. INTRODUCTION[1]

In this paper, a Computable General Equilibrium (CGE) model is used to explore quantitatively the short-run impact of agricultural deprotection on the Moroccan economy in general and on disaggregated household welfare and the rural economy in particular. In addition to trade policies *per se*, the analysis also addresses the use of complementary policies aimed at protecting the incomes of vulnerable parts of the rural population.

Section 2 provides a brief background on the Moroccan economy and economic policy, with a focus on agriculture and rural areas. In Section 3, the CGE model and its data base are presented; Section 4 is devoted to simulations while Section 5 summarizes the results and extracts the policy implications. The appendices of the paper include a mathematical model statement as well as additional background data and simulation results.

2. BACKGROUND

The focus of this paper is justified by the fact that Morocco's pervasive and sharp rural-urban divide remains in place. According to data from the early 1990s, rural per-capita consumption is around half of the urban level. While rural areas house less than 50% of the population, they account for 70% of the poor. As shown in Table 2.1, rural areas are also strongly disfavored according to other indicators such as access to electricity and safe water, literacy, and school enrollment, with the female population standing out as particularly disadvantaged. Low educational achievement is reflected in a labor force that for the most part is "unskilled" (in the sense that most jobs require no formal education). The skill gap is a major source of inequality between rural and urban areas; on average skilled workers earn 6-7 times the wage of unskilled workers (Karshenas, 1994). Relatively unfavorable rural conditions have led to rapid rural-urban migration, which provides an important outlet for the rural labor force (absorbing the bulk of its natural growth), but exacerbates urban unemployment and puts downward pressure on urban wages. The rural economy is dominated by

[1] I would like to thank Marc Gehlhar for very kind help with trade data and Moataz El-Said, Rebecca Harris, and Marcelle Thomas for valuable research assistance.

agriculture which represents close to 80% of total employment and may account for some 60% of total rural value-added.[2] In terms of the economy as a whole, agriculture provides somewhat less than 20% of GDP but as much as 45% of total employment, attesting to its relatively high labor-intensity. While agricultural GDP is highly variable, since the early 1980s, the sector has discontinued an earlier secular decline in its share of the economy (see Table 2.2. for a summary of the sectoral structure of the national economy). The agricultural sector is itself marked by considerable heterogeneity, perhaps most importantly between relatively prosperous irrigated zones (17% of the cultivated area in the early 1990s) and disfavored rainfed zones that, *inter alia*, suffer from frequent but irregular droughts. Moreover, the rainfed areas differ greatly in terms of average annual rainfall.

<<Table 2.1>>

<<Table 2.2>>

Morocco's agriculture plays an important role in the country's relatively diversified foreign trade. When processed agricultural products are included, it accounts for around 30% of exports and 20% of imports. The most important agricultural exports are fish, fruits and vegetables. Wheat and sugar are the major agricultural imports (Royaume du Maroc, 1997; EIU, 997-98, pp. 54-55).[3]

Since the early 1980s, Morocco has gradually reformed its economy in the direction of trade liberalization and increased reliance on market forces and the private sector. Morocco's macroeconomic management has since the mid-1980s been more successful than in most other countries in the Middle East and North Africa according to indicators such as rate and volatility of inflation, level of the budget deficit, and stability of the real exchange rate (Page and Underwood, 1997, pp. 104-105). In the trade area, the level and dispersion of tariffs have been reduced while quantitative restrictions have been eliminated (Alonso-Gamo *et al.*, p. 24; IMF 1997, p. 7). Compared to most structural adjustment-oriented countries, Morocco was successful in combining positive

[2] Drawing on the model's Social Accounting Matrix, Table A.2.1 shows shares of different sources in the incomes of households, disaggregated by region (rural and urban) and income group (poor and non-poor).

[3] Unprocessed agricultural products represent around 8% of exports and 6% of imports.

growth with rapid restoration of internal and external balance (Karshenas, pp. 47-48). Nevertheless, compared to the 1970s, economic growth decelerated in the 1980s and even more so during the period 1990-96.[4]

In spite of far-reaching trade reforms, Morocco's still has significant trade barriers with a high degree of dispersion across sectoral protection rates. Table 2.3 shows 1994 data for tariff and non-tariff barriers that are used for the model-based analysis of this paper.[5] As shown, the agricultural trade regime was, as of the mid-1990s, particularly distorted, especially for cereals and animal products.

<<Table 2.3>>

In 1996, Morocco signed an Association Agreement with the European Union (EU), which is Morocco's predominant trading partner, representing 64% of exports and 57% of imports (Royaume du Maroc, 1997, p. 572). In the agreement, Morocco committed itself to a gradual elimination of its barriers to industrial imports from Europe in exchange for aid, technical assistance, and a slight improvement in access to the EU market for its agricultural exports.[6] At this point, major items on the policy agenda include the design of policies that complement the EU agreement.

As Morocco reduces its tariffs on industrial imports from the EU, a major question is whether it will unilaterally pursue general agricultural and industrial import liberalization vis-a-vis the rest of the world. While such policies may have a positive impact on aggregate economic performance, they may also be accompanied by welfare losses for parts of the population. The policy dilemma may be severe given that agriculture is both the most heavily protected sector and the sector that provides

[4] Table A.2.2 summarizes macroeconomic performance and structural change 1970-96.

[5] For the base year, in addition to import tariffs, price comparisons for agricultural products indicate the presence of significant trade barriers that not can be attributed to tariffs or other taxes (Roland-Holst, 1996). The current model treat these as *ad valorem* mark-ups on the prices of selected imports.

[6] With few exceptions, Morocco already enjoys unrestrained access to the EU for industrial commodities.

the bulk of the income of many of the rural poor with limited economic mobility. Moroccan policy makers are well aware of the link between rural welfare and agricultural crop prices — in March 1998, in the very first decree he signed, Morocco's new prime minister Youssoufi imposed a sharp increase in tariff rates on imported wheat to counteract a recent drastic fall in world prices (EIU, 1998, p. 20). In fact, it may be more appropriate to consider agricultural trade liberalization in the context of complementary policies. As an example of policies that can be pursued in the short run, Mexico introduced an income transfer program (PROCAMPO) where farmers were compensated for reduced protection of agricultural markets. By making payments proportional to assessments of past earnings in agriculture, the program aimed at being non-distorting in terms of current production decisions (World Bank, 1997c, p. 40). Over a longer time horizon, options include support for an educational system that is attuned to labor market conditions and the development of an infrastructure that facilitates the development of rural non-agricultural activities.

In this paper, we will use a rural-urban CGE model to explore some of these issues with special emphasis on the impact of trade reforms and complementary policies on the rural economy, the labor market, and the rural poor.

3.MODEL STRUCTURE AND DATA

The current model, which draws on existing economywide models of Morocco, is distinguished by an explicit separation of activities, factors, and households into rural and urban. The disaggregation aims at identifying the rural poor, as well as the factors and activities from which they earn their incomes. Hence, the model has a detailed treatment of aspects that are most closely linked to the rural economy and the welfare of the rural poor, including agricultural and other rural activities, and rural factors of production. Although the treatment of the urban production is more aggregated, the model also permits an analysis of the impact on the urban poor of policies and exogenous shocks. Moreover, the resulting economywide perspective permits us to avoid the fallacy of viewing the rural economy as an isolated island. This is important since the rural and urban economies and the welfare of their households are interdependent with numerous linkages, *inter alia* in the markets for commodities and factors.

Model disaggregation

Table 3.1. displays the disaggregation of activities, factors, and institutions. Among the 41 *activities*, 34 are rural and seven urban. Most rural sectors are part of crop or livestock agriculture. The non-agricultural sectors of the economy (disaggregated into the major types of industrial and service sectors) are classified as rural or urban.

<<Table 3.1>>

Rural activities use rural factors whereas urban activities use urban factors.[7] All activities use capital and labor. Agricultural activities demand additional factors: livestock makes use of pasture-fallow land; crop activities rely on rainfed land; irrigated crop activities also use water. Outside agriculture, the labor force of each activity includes both skilled and unskilled labor whereas for all agricultural activities except fishing and forestry, the labor force is made up of a separate category of (unskilled) agricultural labor.

In crop and livestock agriculture, most activities produce multiple commodities and most commodities are produced by two activities, one in rainfed and one in irrigated areas. Fodder byproducts are produced by most crop activities. Livestock activities produce meat and milk (disaggregated by animal type) and, for the cow activities, manure. Multiple-output activities produce their commodities in fixed physical proportions.

Outside crop and livestock agriculture, each activity produces only one commodity. Given that service commodities tend to have location-specific characteristics, rural and urban service activities are viewed as producing distinct commodities. For industrial and agricultural commodities, markets are treated as integrated across regions (irrigated and rainfed agricultural zones or rural and urban regions) and with international trade.

The model includes four household types, disaggregated by region (rural and urban) and income level (poor and non-poor). The other institutions consist of the government and the rest of

[7] There is one exception to this: the public administration activity uses a combination of urban and rural labor.

the world, divided into the European Union (EU) and non-EU in the area of goods trade. The rest of the world is thus disaggregated given that one purpose of the analysis is to understand the impact on rural development from Morocco's partnership agreement with the EU.

Production activities

Producers are assumed to maximize profits given their technology and the prices of inputs and outputs. As shown in Figure 3.1, the technology of the production activities is specified as a Leontief function of aggregate value-added and an aggregate intermediate input. Value-added is produced by a CES function (of primary factors), and a Leontief function of intermediate input use. In order to permit technique change in response to significant price changes for inputs, the intermediate coefficients are flexible inside agriculture but fixed for other sectors. For irrigated crop agriculture, an aggregate land-water factor is among the arguments in the CES function. This aggregate factor is produced by a set of alternative factor-aggregation activities based on Leontief technology that specifies substitution possibilities between land and water along a linearized CES isoquant. This Leontief representation is preferred to a continuous CES function to allow for the possibility of water or land being in excess supply, with a corresponding price of zero for the non-scarce factor.

<<Figure 3.1>>

The income of each factor is allocated to domestic institutions (the households and the government) in fixed shares, after adjustments for factor payments to and from the rest of the world (both of which are fixed in foreign currency).

Institutions

Both rural and urban *households* receive the bulk of their incomes from factor earnings in their respective regions. Compared to the non-poor, the poor in both regions depend more heavily

on labor incomes in general and unskilled labor incomes in particular.[8] (See Table A.2.1 for base data 1994 income shares.) In addition to factor income, households receive transfers from the government (the transfer received by each household is a fixed GDP share) and the rest of the world (fixed in foreign currency). Total household income is used to pay direct taxes, save and consume. Direct taxes and savings are fixed shares of household income. Consumption demand is determined by the linear expenditure system (LES).

Besides factor incomes, *government* revenue consists of taxes — direct taxes from households, indirect taxes from domestic activities, domestic sales taxes, and import tariffs (with different rates applying to EU and non-EU goods' imports). All taxes are *ad valorem*. Apart from the above-mentioned transfers to households, the government uses its income to buy a fixed quantity of consumption goods, transfers to the rest of the world (fixed in foreign currency), and consumer subsidies (a fixed share of the consumption value for manufactured goods, representing food items).

The *rest of the world* interacts with Morocco through commodity trade and the above-mentioned transfers (which add to or deduct from the incomes of factors and domestic institutions).

System constraints

System constraints, or "closure rules" are those constraints that have to be satisfied by the economic system, but which are not considered in the decisions of any micro agent (Robinson 1989, pp. 907-908). They consist of the markets for commodities and factors as well as a set of macro aggregates. We will here present the system constraints of the basic model version; alternative configurations, described later, are used in a subset of the model simulations.

Commodity markets

Commodities are supplied by domestic production activities and imports. On the other side of the market, we find domestic demand and exports. Imperfect substitutability is assumed for

[8] See Table A.2.1 for base data 1994 income shares derived from the Social Accounting Matrix.

commodities from different sources (different domestic activities, different import regions, or the outside world versus domestic producers). Commodities delivered to different destinations (domestic market vs. aggregated export market or different export markets) are imperfectly transformable.

Figure 3.2. summarizes the commodity flows that underlie the market for a commodity that is produced by two activities and is traded in both directions, both with the EU and the rest of the outside world. A separate price is associated with each commodity flow (box).

<<Figure 3.2>>

In the bottom left, production from the two activities combine to form aggregate output that, in turn, is transformed to domestic sales and aggregate exports. In the next stage, the latter are further transformed into exports to the EU and the rest of the world. On the domestic supply side, imports from the EU and the rest of the world generate aggregate imports that, together with domestic sales, are aggregated to give domestic composite commodity supply. On the other side of the composite commodity market, demand is made up of household and government consumption, investment, and intermediate input use. The above Figure is simplified for commodities that enter international trade in a less complete fashion (or not at all for non-traded commodities) and/or are supplied by a single domestic activity. Moreover, for imported service commodities, the first step in the aggregation is eliminated since imports are not disaggregated by source.

The functional forms for transformation and aggregation are, respectively, Constant-Elasticity-of-Substitution (CES) and Constant-Elasticity-of-Transformation (CET) functions. At each stage, the shares of commodities from different sources or to different destinations are sensitive to relative prices. These assumptions embodied in these functions — imperfect substitutability and transformability — grant the domestic price system a certain degree of independence from international prices and dampen responses of imports, exports and domestic sales to price changes.

With the partial exception of export and import markets, prices performs the role of clearing the markets — the quantities supplied and demanded are, respectively, positively and inversely related to the price. For imports, the supply side clears the market: it is assumed that Morocco is a small-country facing infinitely elastic supplies at exogenous world prices.

For most exports, it is similarly assumed that Morocco is a small country facing infinitely elastic demands at an exogenous world price: in this setting, the demand side clears the market. The only exception is for agricultural exports to the EU. A dual-regime formulation is used according to which an increase in Morocco's supply price will give rise to reduced exports along a constant-elasticity demand curve. However, a decrease in the Moroccan price will not give rise to a corresponding increase in demand. The EU will purchase the base-year quantity at the (lower) price, in the process capturing the rent produced by the constraint. As a result, the EU pays exactly the price needed to induce Morocco to export the fixed quantities.

Factor markets

The treatment of factor markets in the basic model version is summarized in Table 3.2. Among the *agricultural resources*, it is assumed that rainfed land and pasture-fallow are mobile across activities, and fully utilized with a market-clearing price. The only exception is tree crops, for which, given the short-run nature of the analysis, land use is fixed.

<<Table 3.2>>

In irrigated agriculture, land is used in conjunction with irrigation water. Both water and irrigated land are mobile across activities, once again with the exception of tree crop land use. For this sector, the model allows for the fact that flexibility in technique choice may not be sufficient to assure that both factors always are scarce. Hence, for each factor, two regimes are possible: full employment with a market-clearing price or unemployment with the utilization level as the clearing variable. However, in practice at most one of the two factors would be unemployed at any given point in time.

Both the rainfed and the irrigated *capital* factors are mobile and fully utilized with a market-clearing price. Given the short-run perspective of the model, the capital use of each livestock activity (primarily represented by the animals themselves) is fixed at base level. For agricultural activities that are not classified as irrigated or rainfed (other animal, fishing and forestry) and all non-agricultural

sectors (both rural and urban), the treatment of capital is uniform: capital stocks are activity-specific, and fully utilized with a market-clearing price.

For the *labor* market, two alternative formulations are used, a "rigid" alternative that is more relevant for a shorter time frame and a "flexible" alternative that is more applicable over a longer time frame, in particular if complementary measures that enhance flexibility are put in place. For the "rigid" alternative, the rural labor market is divided into three segments (agricultural, rural unskilled, and rural skilled) while the urban market consists of two segments (unskilled and skilled). In each segment, the wage (price) clears the market in a setting with fixed (full) employment. For the "flexible" alternative, migration is permitted within each skill group, in effect creating an integrated national market segmented by skill. For both alternatives, demand changes within a labor segment give rise to wage changes, not changes in employment. When migration is permitted, it performs the role of maintaining base-year relative wage gaps. Hence, *ceteris paribus*, upward wage pressure in the urban unskilled labor market will induce an inflow of labor from the other two segments to which it is linked (agricultural unskilled and rural unskilled labor) up to the point where the relative wage rates are retained.

Macro constraints

These constraints determine the manner in which the balance is generated for the macro aggregates, associated with the accounts for the government, the rest of the world, and savings-investment. Government savings — the difference between the government's *current* revenues and *current* spending — are fixed. Proportional adjustments in the direct tax rates of urban and rural non-poor households assure that the savings target is met. The real exchange rate (an index of the ratio between the prices of traded commodities and domestic outputs sold domestically) clears the balance of the rest of the world while foreign savings are fixed. On the spending side of the savings-investment balance, aggregate investment is fixed in real quantity terms. On the savings side, the

savings rate of the non-poor urban household is assumed to be flexible, varying to generate a level of total savings needed to finance aggregate investment.[9]

Database

The model data is based on a disaggregated Social Accounting Matrix (SAM; a 108x108 matrix) for 1994, to which the model parameters are calibrated. The SAM was constructed on the basis of data from various sources, most importantly: (i) disaggregated agricultural information from the Moroccan government, the World Bank, and the FAO, primarily for 1990/91;[10] (ii) a disaggregated economywide framework represented by SAMs for 1990 and 1994, an input-output table for 1990, as well as data on the 1994 policy regime — taxes, subsidies, and non-tariff barriers (Bussolo and Roland-Holst, 1993; Roland-Holst, 1996a); (iii) 1994 macro and trade data from Royaume du Maroc (1997), the RMSM data base (World Bank, 1997a), and United Nations (1998); and (iv) disaggregated population, consumption, and labor force data from Royaume du Maroc (1993, 1995, 1996, 1997), World Bank (1994, 1995, 1997a, 1997b), International Monetary Fund (1997), and Karshenas (1994). It should be emphasized that in areas where detailed information was lacking (for example regarding wage gaps across different activities), some simplifying assumptions had to be imposed. In doing so, we were guided by the underlying premise of the analysis: the impact of trade policy on the rural economy cannot be properly assessed without a model structure that captures the salient characteristics that are related to the urban-rural divide, including large skill and wage gaps, labor market segmentation, and differences in sectoral structure.

Available information was brought together in one matrix, the disaggregation of which parallels the disaggregation of the current model. Underlying the construction of such a SAM is an

[9] Savings from the other sources — government, the rest of the world, and other households — are not free to equilibrate aggregate savings-investment. Government and rest-of-the-world savings are fixed while savings of other households are a fixed share of income after direct taxes.

[10] The Moroccan government sources include MAMVA (DPAE/Division des Statistiques and DPV, AGER, DPA, and ORMVA), Ministère des Incitations à l'Economie (Direction de la Statistique), Ministère des Finances, Ministère de l'Industrie, Ministère des Travaux Publics, and Caisse de Compensation.

attempt to make the best possible use of available scattered data. Inevitably imbalances appear when data from different sources and years are integrated in one framework; cross-entropy method was used to generate a balanced model SAM that uses all the information contained in the original data set (Thissen and Löfgren, 1998; Robinson *et al.*, 1998). A macro version of the model SAM — identical to the disaggregated SAM except for the aggregated depiction of factors, household, activities, and commodities — is shown in Table 3.3. A variety of other studies of Morocco were consulted for estimates of elasticities for the Armington, CET, CES (production), LES (household consumption), and export-demand functions.[11]

<<Table 3.3>>

Solution approach and time frame

The current model is solved as a mixed-complementarity problem (MCP), consisting of a set of simultaneous equations that are a mix of strict equalities and inequalities but without an objective function. This approach, made feasible by the recent development of solvers, makes it possible to formulate a model that combines desired features of mathematical programming models (in particular by permitting excess supplies of agricultural resources, such as water) while allowing the full range of assumptions for consumer demand, government policies, and foreign trade that appear in standard

[11] The consulted studies include Aloui *et al,.* 1989; de Janvry *et al*., 1992; Goldin and Roland-Holst, 1995; Laraki, 1989, Mateus *et al.,*1988; Morrisson, 1991; and Rutherford *et al.,* 1993. In summary, the values used include: 1. Elasticity of substitution for CES value-added functions: 0.8 for all activities except Public Administration (0.19); 2. Elasticity of substitution for CES intermediate-input aggregation functions for agricultural activities: 0.5 for all activities except vegetables (2.0); 3. CES (Armington) function elasticities for aggregation of imports from different regions and of imports and domestic output: between 2 and 5 for all commodities; 4. CET function elasticities for transformation of domestic output to aggregate exports and domestic sales and of aggregate exports to exports disaggregated by region: between 2 and 5 for all commodities; 5. Elasticities for constant-elasticity export demand functions for agricultural exports to the EU and for service exports: -1.5.

CGE models. The GAMS modeling software is used both to generate the database and to implement the model. The model is solved with PATH, a solver for mixed complementarity problems.[12]

The base solution of the model is calibrated to exactly replicate the disaggregated 1994 SAM. In the different simulations, the model is run in a comparative static mode. The results indicate the short-run equilibrium responses to changes in policies and exogenous shocks, comparing a new solution to the base solution. Each new solution represents a new equilibrium since agents (producers and consumers) have fully adjusted themselves to new prices and incomes. It refers to the short run since capital stocks outside crop agriculture are fixed by activity: the time span is too short for current investment to lead to changes in installed capital or for capital to move between non-crop sectors (cf. Hazell and Norton, 1986, p. 300).

4. SIMULATIONS

The simulations, based on the CGE model presented in the preceding section, explore the impact of removing border protection with a focus on disaggregated household welfare and the rural economy. As shown in Table 4.1, we will cumulatively introduce 25% cuts in the different import barriers that affect agriculture and industry. The simulations will be implemented with two alternative sets of assumptions regarding the flexibility with which labor can be reallocated between different activities (see Table 3.2). We will also investigate the role for complementary policies that in a relatively non-distorting manner counteract negative effects of reduced border protection on the rainfed sector. Throughout the simulations, proportional variations in the direct tax rates of non-poor households (urban and rural) assure that government savings are fixed in real (CPI-indexed) terms. Given that reduced tariff rates have a negative impact on the government balance, this mechanism for balancing the government budget is pro-poor.

<<TABLE 4.1>>

<<TABLE 4.2>>

[12] For GAMS, see Brooke *et al.* (1988). Rutherford (1995) provides more information on PATH.

The results for the first set of simulations are displayed in Table 4.2. In the first simulation (AGLIB-1), the tariff cut will, *ceteris paribus*, boost imports, reducing demand, prices and factor returns for domestic agriculture. Lower agricultural prices benefit consumers and sectors that use intermediate inputs from agriculture. An increase in agricultural imports generates a slight current-account deficit and a depreciation in the real exchange rate, boosting exports and reducing imports throughout the economy. Welfare changes for any household group primarily depend on the combined effects of changes in the prices of factors it controls and commodities it consumes.

As expected, the incomes of agricultural labor and resources decline significantly, especially in rainfed areas since these depend most heavily on livestock production — initially the most highly protected sector. All other factor incomes increase. On the aggregate level, urban factors gain whereas rural factors face a significant decline.

The results on the household level are driven by these changes in factor incomes. Rural households, especially the poor, who depend the most on rainfed agriculture and labor, lose, while both urban household groups gain. The aggregate welfare effect is mildly positive. There is only a slight decline in tariff revenue relative to GDP, reflecting the fact that tariffs from agricultural imports only represent a small part of total tariff revenue and the trade expansion that takes place. As a result of the assumed rigidity of the labor market (*inter alia* keeping the agricultural labor force inside agriculture), less than 0.1% of the labor force moves between activities.[13]

As non-tariff barriers (initially very high for wheat and livestock products) are cut by a quarter in the second simulation (AGLIB-2), the results from the first simulation are reinforced. Changes in factor incomes are further accentuated, with an additional decline in aggregate rural incomes, driven by a drastic fall in the incomes of rainfed resources and unskilled labor. Rural welfare declines while urban households gain, with a significant boost in aggregate household welfare. Since, in this simulation, imports expand without any additional tariff cut, tariff revenue is boosted, approximately returning to the base level.

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[13] For this indicator, a job shift is defined as a move from one activity to another. All activities are defined at the most disaggregated level except for crop and livestock agriculture, which is defined as a single aggregate activity. Hence, unless migration is permitted, the agricultural labor force cannot change jobs, as here defined.

In the following two simulation, industrial tariffs are cut by a quarter, starting with imports from the EU (AGINDLIB-1) and then extending the reduction to industrial imports from other parts of the world (AGINDLIB-2). Compared to the preceding scenario, import tariffs decline significantly (by 1.3% of GDP for AGINDLIB-2) and, to maintain the fixed current account deficit, the currency depreciates (by 3.7%). There is a compensating increase in direct taxes with a negative impact on the welfare of the non-poor. Urban factor incomes are boosted while rural incomes are largely unchanged. The increase in job shifts imply a growing pressure for labor-market restructuring. Among the households, the urban poor gain significantly whereas others are relatively unaffected. The fact that there is a slight decline in aggregate welfare reflects that the tariff cuts are introduced in a second-best world with significant policy-induced price distortions and severe rigidities, limiting resource mobility and agricultural export expansion.[14] In sum, this first set of simulations demonstrates that, in a rigid short-run equilibrium setting, agricultural deprotection involves a tradeoff between significant gains in aggregate and urban welfare and significant losses in rural welfare. Among the four households categories, it is the poor who are most strongly affected, negatively in rural areas and positively in urban areas.

The first set of simulations assumes a rigid labor market. In the second set of simulations the labor market is more flexible as rural and urban labor markets, disaggregated into skilled and unskilled, are linked via migration. Migration assures that relative wage differences are fixed at the initial ratios, bringing about migration from (to) labor segments which, in the absence of migration would face a wage decrease (increase) relative to other segments. In this new setting, the income change for any worker depends on the impact of the policy changes in his or her broader labor market (skilled or unskilled) as opposed to the more disaggregated markets (for skilled workers, rural or urban; for unskilled workers, agricultural, rural, or urban) that were in operation in the first set of simulations.

The results, shown in Table 4.3, bring to the fore the important role of the functioning of the labor market. A simulation-by-simulation comparison between Tables 4.3 and 4.2. shows that the

[14] It may also be noted that because of its relatively aggregate representation of industry, the model implicitly exaggerates the initial unity of tariff rates across sectors and, by consequence, understates the efficiency gains from across the board tariff cuts.

aggregate welfare gain is uniformly stronger when the labor market is more flexible. The major migration flow is from the agricultural unskilled market (losing 1-5% of its labor force) to the rural and urban markets for unskilled non-agricultural labor (whose relative gains in labor force are of similar magnitude). Income changes in each disaggregated segment of the labor market are less extreme, a reflection of the fact that labor demand is inelastic: as migration increases (decreases) the supply in any segment, labor income in that segment decreases (increases). From another perspective, the adjustment cost in the labor market is much larger: the share of the labor force that shifts jobs is 1.5-2% for the simulations that include reduced tariffs and non-tariff barriers for agriculture, *i.e.*, 4-6 times as large as for the corresponding simulations with a rigid labor market. Less extreme changes in labor returns engender smaller shocks in household spending patterns and less pronounced discrepancies in gains and losses for non-labor factors throughout the economy. Among the agricultural factors, rainfed resources and unskilled labor continue to incur significant losses, albeit on a smaller scale. Other agricultural resources are only affected marginally. On the household level, the net effect is that both rural households gain strongly whereas the urban poor lose equally strongly as migration into the urban unskilled labor market drives down wages.

<<Table 4.3>>

Otherwise, the pattern of change is similar to that of the simulations in Table 4.2. Agricultural deprotection raises aggregate welfare but the decline in factor incomes within rainfed agriculture is significant and the rural poor lose. Additional industrial deprotection has a minor negative aggregate impact but improves the welfare of the poor in both regions. This distributional pattern is in part due to the fact that only non-poor households carry the burden of financing a decline in government savings with higher direct tax payments.

In light of these results — significant pros and cons of trade deprotection — a third set of simulations investigates the potential impact of complementary policies aimed at protecting the vulnerable groups that would be affected most severely without undoing the economywide gains from deprotection. In these simulations, three alternative changes are introduced in the context of the

scenario AGINDLIB-1 with a flexible labor market: (i) a transfer program that compensates owners of (non-labor) rainfed resources for lost factor income due to reduce trade barriers, with direct taxes from the non-poor covering the need for financing (TRANSFER); (ii) skill-upgrading where 1% of the unskilled labor in agricultural and other rural activities move to the skilled rural labor force (SKILL UPGRADE); and (iii) a 3% increase in total factor productivity (TFP) for all rural non-agricultural activities (RURNAG TFP; see Table 3.1 for a definition).

Table 4.4. summarizes the results, for the sake of comparison also including the AGINDLIB-1 scenario under the same assumption of a flexible labor market. The impact of compensatory transfer payments is almost exclusively distributional. In this specific setting, the cost of the scheme amounts to 0.8% of GDP. (The cost would be higher if the administrative costs of the program were accounted for.) Since the indirect effects are small, the tax increase is of the same magnitude. The recipients, primarily rural households, gain significantly. The relative gain is larger for the poor (5% versus 1.5% for the non-poor), since rainfed resources represent a larger share of their incomes and they do not share in covering the cost. On the other hand, the rural non-poor, who finance the program without receiving but a minor share of the resulting payments, lose 0.7% in real welfare. After the transfer, the different households quite evenly share the gains from trade liberalization.

<<Table 4.3>>

The upgrading of rural skills has stronger economywide effects, raising aggregate welfare by 0.6%. Both rural households gain significantly and, compared to the situation in 1994, more than their urban counterparts. In urban areas, the poor gain while the non-poor lose. These effects are driven by events in the labor markets. The incomes of the rural households increase since part of their labor force now collects significantly higher wages. Downward wage pressure in the skilled labor segment drives down wages and incomes for the urban non-poor households who control most of the initial skilled labor stock. The urban poor gain since they earn the bulk of their incomes from unskilled labor, the supply of which declines as a result of the skill upgrade. Domestic expansion boosts imports which, in turn, bring about depreciation of the real exchange rate to keep the current-account deficit in check, in the process raising the degree of economic openness.

Finally, we simulate an increase in the TFP of the rural non-agricultural activities, If the price elasticity of demand is high (for example for the manufactured sector, which is well-integrated with the world economy), TFP growth is likely to benefit the owners of scarce activity-specific inputs; on the other hand, if the elasticity is lower (for example for rural services), the gain is most likely to accrue to consumers and activities demanding intermediate inputs. The results indicate that the latter situation predominates. A decline in the rent income of rural non-agricultural capital shows that the aggregate demand elasticity is relatively low (cf. Binswanger, 1980, pp. 201-203). Agricultural resource incomes and rural household welfare increase drastically, as producers and consumers benefit from lower prices, especially for rural services. Compared to the other simulations, this scenario gives rise to the largest economywide boost in household welfare. Apart from the urban poor, who are relatively unaffected, all household groups gain, especially the rural households.

5. CONCLUSION

In this paper, a CGE model with a relatively detailed treatment of the rural economy has been used to address the short-run equilibrium effects of agricultural and industrial deprotection in Morocco. The contribution of this study stems from its focus on the impact of trade policies and complementary policies on the rural world, using a model that captures salient characteristics of Morocco's rural-urban divide, including large skill and wage gaps, labor market segmentation, and difference in sectoral structure. The analysis is exploratory — it does not try to mimic any specific liberalization scheme. Rather, it tries to further our understanding of the relative importance of some of the factors that condition the impact of trade liberalization in Morocco.

Three sets of simulations are carried out. The results from the two first sets indicate that reduced agricultural border protection would generate significant aggregate welfare gains at the same time as a large part of the disadvantaged rural population would lose. The impact of industrial tariff cuts are small, a reflection of that these tariffs have a relatively limited impact on domestic price distortions. The results also suggest that, over a slightly longer time frame where migration is feasible, the outcome would be more favorable for the rural households. Nevertheless, for policymakers that are concerned with both aggregate and rural well-being, the results present a dilemma.

The third and last set of simulations suggests that this dilemma may be overcome if reduced border protection can be introduced in the context of a policy package that includes some combination of government transfers to owners of rainfed agricultural resources, and government investments in education and infrastructure. Significant time lags are involved before some of these compensatory measures can be implemented or make their effects felt. Hence, if the government wants to reduce agricultural protection while protecting the rural population, it is urgent to start putting compensatory policies in place immediately. A gradualist approach to deprotection would also make it easier to manage the tradeoff between aggregate and rural welfare.

Finally, on the methodological level, the analysis suggests that an economy-wide approach adds to the understanding of the welfare effects of agricultural policy change: the results are strongly influenced by links between agriculture and the rest of the economy in markets for commodities, factors, and foreign exchange, as well as via the government budget.

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TABLES AND FIGURES

Table 2.1. Social and economic indicators: nation-wide and by locale (rural and

	Rural	Urban	Total
Population (1994)			
mn	12.7	13.4	26.1
%	48.6	51.4	100.0
Annual population growth (1982-1994)			
Natural	2.6	1.7	2.2
Post-Migration	0.7	3.6	2.0
Poverty rate (1991)	18.0	7.0	13.1
Electricity access (1994)	9.7	80.7	46.2
Safe water access (1994)	4.0	74.2	40.1
Illiteracy rate (1994)			
Male	61.0	25.0	41.0
Female	89.0	49.0	67.0
Total	75.0	37.0	55.0
Primary school enrollment rates (1991)			
Male	56.5	86.7	69.9
Female	29.9	84.7	52.8
Total	43.2	85.7	61.3
Labor market data (1995)			
Labor force			
'000	5,024.4	4,982.1	10,006.4
%	50.2	49.8	100.0
Participation rate	39.5	36.0	37.7
Unemployment			
'000	384.2	1,111.7	1,495.9
% (of labor force)	7.6	22.3	14.9
Employment			
'000	4,640.2	3,870.4	8,510.5
%	54.5	45.5	100.0
Skilled labor (% of total)	5.6	41.1	21.7

Note: Units are in percent (unless otherwise indicated)

Table 2.2. Structure of production and employment, 1994-1995

		Employment		
	GDP	Rural	Urban	Total
(%)				
Agriculture	18.5	77.0	6.3	44.8
Industry	26.5	9.3	27.2	17.5
Construction	4.3	4.1	7.1	5.4
Government Administration	12.2	0.9	11.5	5.7
Other services	38.4	8.7	47.9	26.5
Total	100.0	100.0	100.0	100.0
Total (bn Dh or '000 workers)	279.3	4640.2	3870.4	8510.5

Note: Units are in percent (unless otherwise indicated).
GDP data are for 1994; Employment data are for 1995.
GDP is in bn Dh. at market prices; employment is in '000 workers

Table 2.3. Tariff and non-tariff rates and values for Morocco, 1994.

	Non-tariff barrier (%)	Aggregate tariff rate (%)	EU tariff rate (%)	Non-EU tariff rate (%)	Aggregate tariff revenue (mn Dh)	EU tariff revenue (mn Dh)	Non-EU tariff revenue (mn Dh)
Hard wheat	29.5	16.3		8.5	47.7		47.7
Soft wheat	87.0	16.2	8.3	8.0	195.9	92.8	103.1
Barley		25.2	10.9	18.9	24.2	16.3	7.8
Maize		19.2	8.2	10.4	102.0	31.9	70.2
Sunflower		29.2		14.8	92.0		92.0
Other industrial crop		29.4	9.2	17.7	260.0	57.6	202.4
Vegetable		10.8	7.6		19.1	19.1	
Olive		51.1	23.3	30.4	16.8	10.6	6.3
Other fruit		52.3		30.7	13.6		13.6
Beef	86.4	88.8	44.4		127.5	127.5	
Sheep-goat meat	125.3	91.2		45.6	19.2		19.2
Sheep-goat wool	128.7	90.9		45.4	2.2		2.2
Other animal	90.7	88.2	43.9	45.2	749.7	631.7	117.9
Forestry		3.0	9.7		8.0	8.0	
Fishing		68.4	34.2		8.2	8.2	
Mining		8.4	9.0	3.3	137.5	46.8	90.7
Petroleum		21.3	23.1	8.6	1813.4	566.4	1247.1
Manufacturing	1.3	30.5	16.4	12.9	16807.1	12071.0	4736.1
Total		28.7	33.2	22.4	20443.9	13687.8	6756.1

Source: Model SAM.

Table 3.1. Disaggregation of activities, factors, and institutions.

No.	Sets		Elements
45	Activities		
38	Rural		
15		Irrigated crops	Soft wheat Hard wheat Barley Maize Other cereal Legumes Fodder Sugarbeet Sugarcane Sunflower Other industrial crop Vegetable Olive Citrus Other fruit
2		Irrigated livestock	Cow Sheep-goat
13		Rainfed crops	Soft wheat Hard wheat Barley Maize Other cereal Legumes Fodder Sugarbeet Sunflower Other industrial crop Vegetable Olive Other fruit
2		Rainfed livestock	Cow Sheep-goat
3		Other agriculture	Other animal Forestry Fishing
3		Rural non-agriculture	Manufacturing Construction Other service

Table 3.1. Cont'd.

Sectors	Sets	Description
7	Urban	Mining
		Petroleum
		Electricity
		Manufacturing
		Construction
		Other service
		Public administration
24	Factors	
15	Rural	
3	Labor	Agricultural unskilled
		Other unskilled
		Skilled
9	Capital	Irrigated Cow
		Irrigated Sheep-goat
		Rainfed Cow
		Rainfed Sheep-goat
		Rainfed crop
		Irrigated crop
		Other animal
		Forestry
		Fish
3	Other	Rainfed land
		Water-land aggregate [1]
		Pasture-fallow
9	Urban	
2	Labor	Unskilled
		Skilled
7	Capital	Mining
		Petroleum
		Electricity
		Manufacturing
		Construction
		Other service
		Public administration
4	Households	
2	Rural	Poor
		Non-poor
2	Urban	Poor
		Non-poor
3	Other institutions	
1	Government	Government
2	Rest of the world	EU
		Other

[1] Aggregation of the sub-factors irrigated land and water.

Figure 3.1. Technology for Production Activities

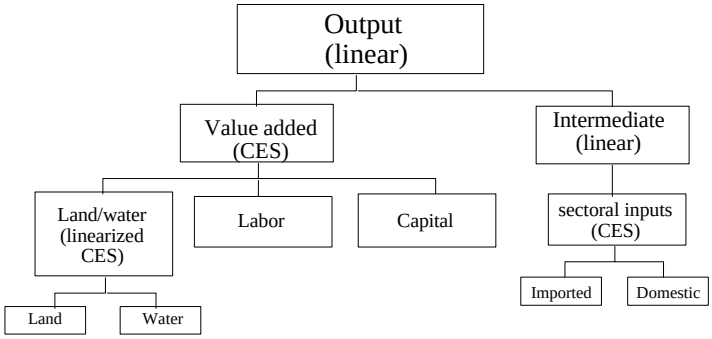
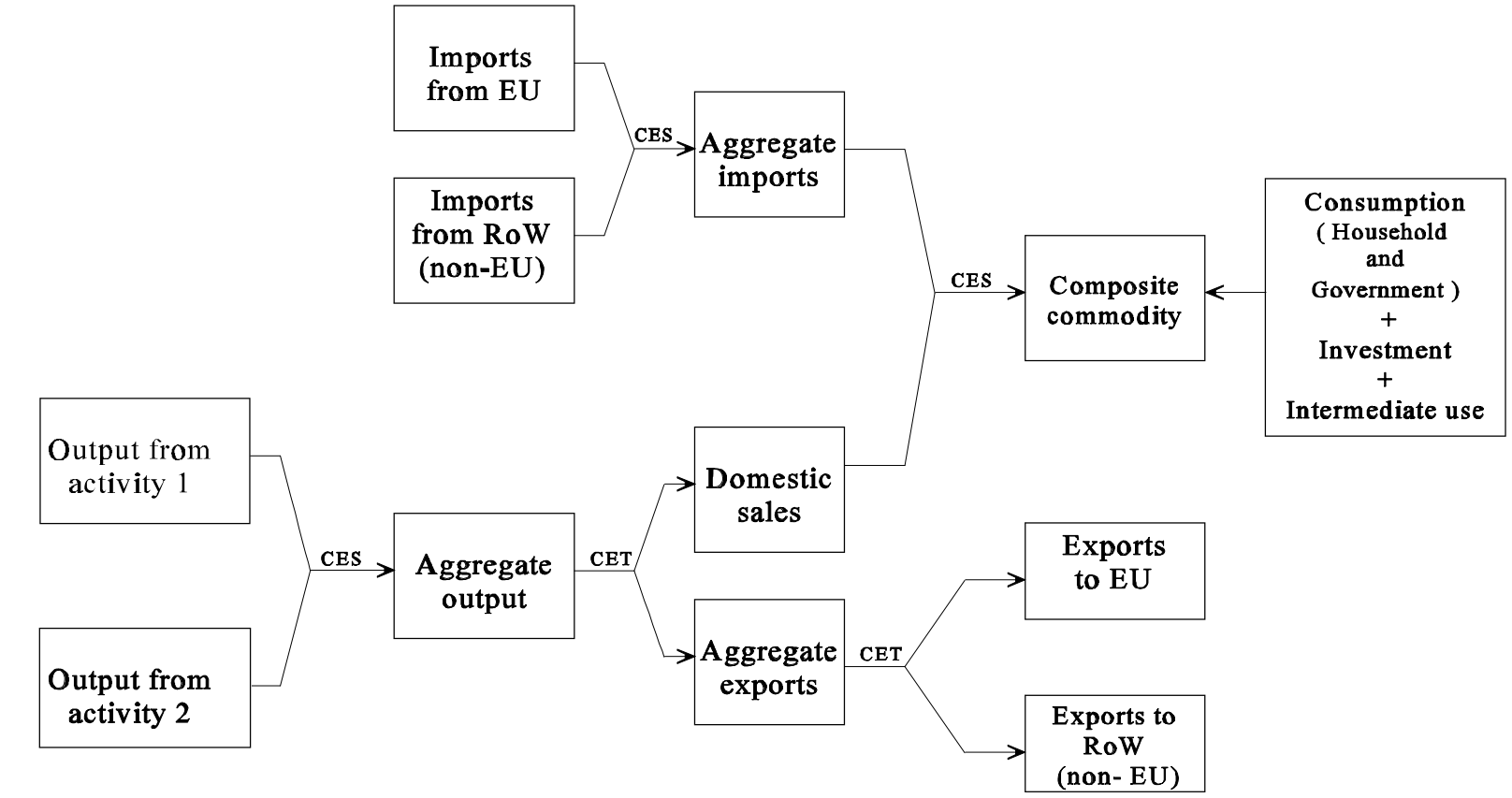


Figure 3.2. Commodity flow in CGE model



Note: CES = constant elasticity of substitution
CET = constant elasticity of transformation
EU = European union
RoW = rest of the world

Table 3.2. Factor markets in basic model version

Factor	Mobile across activities	Utilization	Market-clearing variable
Agricultural Resources			
Rainfed land	Yes*	Full	Price
Pasture-fallow	Yes	Full	Price
Irrigated land	Yes*	Full/unemployment**	Price/utilization
Water	Yes	Full/unemployment**	Price/utilization
Capital			
Rainfed crops	Yes	Full	Price
Irrigated crops	Yes	Full	Price
Livestock	No	Full	Price
Other agriculture***	No	Full	Price
Non-agriculture (urban and rural)	No	Full	Price
Labor			
Rigid alternative			
Separate market for each category (5 markets)****	Yes	Full	Price
Flexible alternative			
Integrated markets for each skill level (2 markets)*****	Yes	Full	Price

*Except for tree crops, for which land is activity-specific (fixed quantities for each tree crop), both for irrigated and rainfed land.
**Dual regime with full employment and a flexible price or unemployment with price at zero.
***Other agriculture = other animal, forestry, fish
****The five labor markets are agricultural unskilled, other rural unskilled, urban unskilled, rural skilled, urban skilled.
****The two labor markets are unskilled and skilled.

Table 3.3. Macro SAM for Morocco, 1994 (billion current Dh.)

	Factors	Institutions			S-I	Activity	Commodity	Tax/Sub/Tariff				Total
	1.	2a.	2b.	2c.	3.	4.	5.	6a.	6b.	6c.	6d.	7.
1. Factors						238.35						238.35
2. Institutions												
2a. Household	232.92		7.74	21.42								262.07
2b. Government	5.38	2.02						15.21	23.70		20.47	66.78
2c. Rest of World	0.06	5.55	7.04				86.21					98.85
3. Savings-Investment		45.05	8.03	6.69								59.77
4. Activities							639.75					639.75
5. Commodities		194.24	40.78	70.75	59.77	392.12	7.97			3.20		768.81
6.Tax/Sub/Tariff												
6a. Direct Taxes		15.21										15.21
6b. Indirect Taxes						9.28	14.42					23.70
6c. Subsidies			3.20									3.20
6d. Import Tariffs							20.47					20.47
7. Total	238.35	262.07	66.78	98.85	59.77	639.75	768.81	15.21	23.70	3.20	20.47	

Table 4.1. Simulation assumptions*

	AG-LIB1	AG-LIB2	AG-IND-LIB1	AG-IND-LIB2
Agricultural tariffs	-25%	-25%	-25%	-25%
Agricultural NTBs		-25%	-25%	-25%
Industrial tariffs				
EU			-25%	-25%
RoW				-25%

*-25% means that, after the change, the rates for relevant commodity tariffs or non-tariff barriers are three quarters of the initial rate. (For example, if the initial import tariff for an agricultural commodity is 200%, it is reduced to 150% under AGLIB-1.)

Table 4.2. Simulation results: Trade deprotection with rigid labor market

	1994	AG LIB-1	AG LIB-2	AG-IND-LIB1	AG-IND-LIB2
		% change			
Real disposable household income (bn. 1994 Dh.)					
All households	9.4	0.5	1.3	1.1	1.1
Poor Urban household	3.0	1.6	5.0	6.6	7.6
Non-poor Urban household	13.6	1.1	3.2	3.2	3.3
Poor Rural household	2.7	-2.7	-9.2	-9.0	-8.5
Non-poor rural	6.5	-1.0	-3.1	-4.0	-4.1
Real factor income (bn 1994 Dh.)					
Rural	71.4	-1.9	-6.3	-6.5	-6.1
Urban	158.8	1.8	5.7	7.2	8.0
Irrigated resources	7.6	-2.2	-10.4	-12.2	-12.3
Rainfed resources	22.0	-4.6	-15.6	-15.5	-15.0
Other agriculture	2.1	-0.4	1.7	2.9	3.8
Rural non-agriculture capital	12.3	1.2	4.2	4.0	4.5
Urban Capital	70.0	1.7	5.6	6.9	7.4
Agriculture unskilled labor	10.8	-4.4	-14.1	-14.7	-14.4
Rural non-agricultural unskilled labor	6.5	1.0	4.2	4.6	5.3
Rural non-agricultural skilled labor	10.1	1.2	4.2	4.2	4.8
Urban unskilled labor	14.8	1.8	5.9	7.4	8.5
Urban skilled labor	74.1	1.8	5.9	7.4	8.5
Job Shift (% of labor force)		0.1	0.2	0.4	0.5
Real trade quantities (bn 1994 Dh.)					
Exports	70.8	0.2	0.9	3.1	4.2
Agriculture exports	5.7	1.4	4.7	5.1	5.2
Industrial exports	36.3	0.2	1.5	5.1	6.9
Imports	86.3	0.1	0.7	2.3	3.1
Agriculture imports	4.9	3.2	6.2	4.0	3.3
Industrial imports	65.3	-0.2	-0.2	2.7	4.1
Real exchange rate (index 1994 = 100)	100.0	0.8	1.8	3.1	3.7
		(% of GDP)			
Direct tax	5.4	5.6	5.7	6.7	7.3
Tariffs	7.3	7.2	7.3	6.5	6.0

Table 4.3. Simulation results: Trade deprotection with flexible labor market

	1994	AG LIB-1	AG LIB-2	AG-IND-LIB1	AG-IND-LIB2
		(%) change			
Real disposable household income (bn. 1994 Dh.)					
All households	9.4	0.5	1.5	1.4	1.4
Poor urban household	3.0	-0.1	-0.2	0.6	1.3
Non-poor urban household	13.6	0.8	2.3	2.3	2.3
Poor rural household	2.7	-1.2	-4.2	-3.6	-2.9
Non-poor rural	6.5	-0.1	-0.2	-0.6	-0.6
Real factor income (bn 1994 Dh.)					
Rural	71.4	-1.0	-3.3	-3.3	-2.7
Urban	158.8	1.2	4.0	5.2	6.0
Irrigated resources	7.6	0.6	-0.7	-2.0	-1.9
Rainfed resources	22.0	-3.1	-10.6	-10.2	-9.6
Other agriculture	2.1	-1.1	-0.8	0.2	1.0
Rural non-agriculture capital	12.3	0.8	2.8	2.6	3.2
Urban Capital	70.0	1.4	4.3	5.5	6.0
Agriculture unskilled labor	10.8	-2.0	-6.4	-6.4	-6.0
Rural non-agricultural unskilled labor	6.5	0.1	1.0	1.4	2.1
Rural non-agricultural skilled labor	10.1	0.9	3.0	3.4	4.1
Urban unskilled labor	14.8	0.5	1.8	2.9	3.8
Urban skilled labor	74.1	1.3	4.1	5.4	6.4
Job Shift (% of labor force)		0.5	1.6	1.7	1.8
Real trade quantities (bn 1994 Dh.)					
Exports	70.8	0.3	1.3	3.6	4.7
Agriculture exports	5.7	1.0	3.1	3.2	3.2
Industrial exports	36.3	0.2	1.5	5.1	6.9
Imports	86.3	0.1	0.8	2.4	3.2
Agriculture imports	4.9	4.7	11.6	9.8	9.2
Industrial imports	65.3	-0.0	0.3	3.3	4.7
Real exchange rate (index 1994 = 100)	100.0	0.9	2.3	3.6	4.3
		(% of GDP)			
Direct tax	5.4	5.5	5.4	6.3	6.9
Tariffs	7.3	7.3	7.4	6.5	6.1

Table 4.4. Simulation results: Trade deprotection and complementary changes with flexible labor market

	1994	AG-IND-LIB1	TRANS-FER	SKILL UPGRADE	RURNAG TFP
			% change		
Real disposable household income (bn. 1994 Dh.)					
All-households		9.4	1.4	1.4	2.02.5
Poor urban household	3.0	0.6	0.7	2.1	2.4
Non-poor urban household	13.6	2.3	1.5	1.6	2.2
Poor rural household	2.7	-3.6	1.2	2.4	2.6
Non-poor rural	6.5	-0.6	0.9	2.8	2.8
Real factor income (bn 1994 Dh.)					
Rural	71.4	-3.3	-3.0	-1.0	0.0
Urban	158.8	5.2	5.1	4.4	4.9
Irrigated resources	7.6	-2.0	-1.8	3.2	9.6
Rainfed resources	22.0	-10.2	-10.0	-7.2	-2.9
Other agriculture	2.1	0.2	-0.3	2.8	6.5
Rural non-agriculture capital	12.3	2.6	3.4	3.3	-2.5
Urban capital	70.0	5.5	5.3	5.4	5.5
Agriculture unskilled labor	10.8	-6.4	-6.2	-2.9	1.3
Rural non-agricultural unskilled labor	6.5	1.4	1.7	2.8	0.7
Rural non-agricultural skilled labor	10.1	3.4	3.9	2.5	-0.8
Urban unskilled labor	14.8	2.9	2.8	3.6	4.0
Urban skilled labor	74.1	5.4	5.3	3.7	4.5
Job Shift (% of labor force)		1.7	1.7	1.5	1.3
Real trade quantities (bn 1994 Dh.)					
Exports	70.8	3.6	3.6	4.5	5.2
Agriculture exports	5.7	3.2	3.1	2.9	3.4
Industrial exports	36.3	5.1	5.1	5.9	8.0
Imports	86.3	2.4	2.4	2.9	3.6
Agriculture imports	4.9	9.8	10.2	13.6	16.2
Industrial imports	65.3	3.3	3.4	4.1	4.1
Real exchange rate (index 1994 = 100)	100.0	3.6	3.6	3.9	4.2
			(% of GDP)		
Direct tax	5.4	6.3	7.1	6.0	6.1
Tariffs		7.3	6.5	6.6	6.66.6
Government transfer to owners of rainfed			0.8		

1. TRANSFER = AG-IND-LIB1 + government transfer to owners of rainfed (non-labor) resources; 2. SKILL UPGRADE = AG-IND-LIB1 + 1% of the labor force in the unskilled rural labor categories (agricultural and other rural) change status to skilled rural labor; 3. RURNAG TFP = AG-IND-LIB1 + 3% TFP increase for all rural non-agricultural activities.

APPENDIX

Table A.1.1. Mathematical Statement of the static module of the Morocco Rural-Urban CGE Model[1]

Sets	
$a \in A$	activities (=A')
$a \in APRD\ (\subset A)$	production activities
$a \in AFAG\ (\subset A)$	factor-aggregation activities
$c \in C$	commodities
$z \in Z$	factors and institutions (domestic and rest of the world) (=Z')
$f \in F\ (\subset Z)$	factors (=F')
$f \in FA\ (\subset F)$	aggregate factors
$f \in FAFE\ (\subset FA)$	aggregate factors with full employment
$f \in FAUN\ (\subset FA)$	aggregate factors with (potential) unemployment
$f \in FD\ (\subset F)$	disaggregated factors (*irrigated land, water*)
$i \in I\ (\subset Z)$	domestic institutions (households and government)
$h \in H\ (\subset I)$	households
$(a.a\ ) \in MA$	mapping: production activity a is linked to factor-aggregation activity a'

Parameters	
f^{sav}	foreign savings (foreign currency)
$\bar{p}_c^{we}$	world price of exports (foreign currency)
$\bar{p}_c^{wm}$	world price of imports (foreign currency)
$\bar{p}^{d}$	price index for domestic output (non-tradables)
q_f^{s}	supply of (aggregate or disaggregate) factor f
$\bar{q}_c^{dst}$	stock change for commodity c
$\bar{q}_c^{g}$	government consumption
$\bar{q}_c^{inv}$	fixed investment demand for c
$t_{z,z'}$	transfer to institution/factor z from institution/factor z'
w_f^{min}	minimum wage for (potentially unemployed) aggregate factor f
α_{fa}^{f}	quantity of disaggregated factor f per unit of factor-aggregation activity a
α_{ca}^{a}	intermediate input c per unit of production activity a
γ_{ac}	yield of commodity c per unit of production activity a
θ_{if}^{f}	share of domestic institution i in income of aggregate factor f
θ_h^{trg}	nominal GDP share transferred from government to household h
θ_h^{sav}	share of post-tax income of household h to savings
θ_h^{trnr}	share of non-tariff-barrier rent to household h
σ_c	rate of household consumption subsidy for commodity c
τ_h^{h}	direct tax rate for household h
τ_a^{a}	indirect tax rates for activity a
τ_c^{m}	import tariff rate
τ_c^{trnr}	rate of non-tariff barrier
τ_c^{s}	rate of sales tax
ω_c^{dx}	weight of commodity c in domestic sales price index

Table A. 1.1 (con't)

Variables	
e^{g}	government expenditures
e_h^{h}	household consumption expenditures
gdp	nominal GDP at market prices
g^{sav}	government savings
p_a^{a}	output revenue per unit of production activity a
p_c^{d}	price of domestic output sold domestically
p_c^{e}	price of exports
p_c^{m}	price of imports
p_c^{q}	price of composite good
p_a^{va}	value-added (net) price for production activity a
p_c^{x}	average producer price
p_{ac}^{xac}	producer price for commodity c from production activity a
q_a^{a}	level of (production or factor-aggregation) activity a
q_c^{d}	domestic sales of domestic output
q_c^{e}	exports
q_{fa}^{f}	demand for (aggregate/disaggreg.) factor f from (prod./factor aggreg.) activity a
q_{ch}^{h}	consumption demand for c from household h
q_c^{int}	intermediate input demand for c
q_c^{m}	imports of c
q_c^{q}	supply of composite commodity c
q_c^{x}	total output of commodity c
q_{ac}^{xac}	production of commodity c from production activity a
r	exchange rate (units of foreign currency per unit of domestic currency)
w_f	wage of (aggregate/disaggregate) factor f
y_f^{f}	income of aggregate factor f
y^{g}	government income
y_{if}^{if}	income of domestic institution i from aggregate factor f
y_h^{h}	income of household h

Functions	
CES(•)	constant elasticity of substitution
CET(•)	constant elasticity of transformation
LES(•)	linear expenditure system

Table A.1.1 (con't)

EQUATIONS

#	Equation	Domain	Description
Price Block			
1	$p_c^m \quad \bar{p}_c^{wm} \ (1 \ \tau_c^m \ \tau_c^{ntb}) \ r$	$c \in C$	import price in domestic currency
2	$p_c^e \quad \bar{p}_c^{we} r$	$c \in C$	export price in domestic currency
3	$p_c^q \quad \frac{(p_c^d q_c^d \ p_c^m q_c^m)}{q_c^q} (1 \ \tau_c^s)$	$c \in C$	average demand price of composite commodity
4	$p_c^x \quad \frac{(p_c^d q_c^d \ p_c^e q_c^e)}{q_c^x}$	$c \in C$	average producer price of commodity c
5	$p_a^a \quad \sum_{c \in C} \gamma_{ac} p_{ac}^{xac}$	$a \in APRD$	gross price for production activity
6	$p_a^{va} \quad p_a^a (1 \ \tau_a^i) \ \sum_{c \in C} \alpha_{ca}^i p_a^q$	$a \in APRD$	value added (net) price for production activity
Supply and Trade Block			
7	$q_a^a \quad CES[q_{fa,a}^f]$	$a \in APRD$	level of domestic production activity
8[2]	$q_{fa}^f \quad CES \ [w_f, p_a^{va}]$	$f \in FA$ $a \in APRD$	demand for aggregate factor f from production activity a
9	$q_c^{int} \quad \sum_{a \in APRD} \alpha_{ca}^i q_a^a$	$c \in C$	intermediate input demand
10[3]	$\sum_{f \in FD} w_f \alpha_{fa}^f \geq w_{lw} \qquad \left[q_a^a \geq 0 \right]$	$a \in AFAG$	MC ≥ MR for factor-aggregation activity a
11	$q_{fa}^f \quad \alpha_{fa}^f q_a^a$	$f \in FD$ $a \in AFAG$	demand for disaggregated factor f from factor-aggregation activity a
12	$q_{lw,a}^f \quad \sum_{a \in AFAG \mid (a,a) \in MA} q_a^a$	$a \in APRD$	mapping of factor-aggregation activities to production activity a
13	$q_{ac}^{xac} \quad \gamma_{ac} q_a^a$	$a \in APRD$ $c \in C$	output of commodity c from production activity a

Table A.1.1 (con't)

14	$q_c^x \quad CES[q_{ac}^{xac}]$	$c \in C$	output aggregation function for commodity c
15	$q_{ac}^{xac} \quad CES\ [p_{ac}^{xac}, p_c^x]$	$a \in APRD$ $c \in C$	demand for commodity c from production activity a
16	$q_c^x \quad CET[q_c^e, q_c^d]$	$c \in C$	CET function transforming output to exports and domestic sales
17	$\frac{q_c^e}{q_c^d} \quad CET\left[\frac{p_c^e}{p_c^d}\right]$	$c \in C$	FOC for output transformation
18	$q_c^q \quad CES[q_c^m, q_c^d]$	$c \in C$	CES function aggregating imports and domestic sales to composite supply
19	$\frac{q_c^m}{q_c^d} \quad CES\left[\frac{p_c^d}{p_c^m}\right]$	$c \in C$	FOC for commodity aggregation
Institution block			
20	$y_f^f \quad \sum_{a \in APRD} w_f q_{fa}^f$	$f \in FA$	income of aggregate factor f
21[4]	$y_{if}^{if} \quad \theta_{if}^f\ (y_f^f \quad \bar{t}_{row,f} r)$	$i \in I$ $f \in FA$	income of domestic institution i from aggregate factor f
22	$y_h^h \quad \sum_{f \in FA} y_{hf}^{if} \quad \theta_h^{hg} gdp \quad \bar{t}_{h,row} r$ $\theta_h^{ntb} \sum_{c \in C} \tau_c^{ntb} \bar{p}_c^{wm} q_c^m r$	$h \in H$	household income
23	$e_h^h \quad (1 \quad \theta_h^{sav})\ (1 \quad \tau_h^d) y_h^h \quad \bar{t}_{row,h} r$	$h \in H$	household consumption expenditure
24	$q_{ch}^h \quad LES\ [(1 \quad \sigma_c) p_c^q, e_h^h]$	$c \in C$ $h \in H$	household consumption demand
25[5]	$y_g \quad y_{gov,f}^{if} \quad \sum_{h \in H} \tau_h^d y_h^h \quad \sum_{c \in C} \tau_c^s (p_c^d q_c^d \quad p_c^m q_c^m)$ $\sum_{a \in APRD} \tau_a^i p_a^a q_a^a \quad \sum_{c \in C} \tau_c^m \bar{p}_c^{wm} q_c^m \quad \bar{t}_{gov,row}$		government income
26	$e^g \quad \sum_{c \in C} p_c^q \bar{q}_c^g \quad \sum_{h \in H} \theta_h^{hg} gdp \quad \bar{t}_{row,gov} r \quad \sum_{c \in C} \sum_{h \in H} \sigma_c p_c^q q_{ch}^h$		government expenditure
27	$gdp \quad \sum_{c \in C} \sum_{h \in H} p_c^q (1 \quad \sigma_c) q_{ch}^h \quad \sum_{c \in C} p_c^q \bar{q}_c^{inv} \quad \sum_{c \in C} p_c^q \bar{q}_c^{dst}$ $\sum_{c \in C} p_c^q \bar{q}_c^g \quad \sum_{c \in C} p_c^{we} q_c^e r \quad \sum_{c \in C} \bar{p}_c^{wm} q_c^m r$		nominal GDP

Table A.1.1 (con't)

System Constraint Block

28	$q_c^q \quad q_c^{int} \quad \sum_{h \in H} q_{ch}^h \quad \bar{q}_c^g \quad \bar{q}_c^{inv} \quad \bar{q}_c^{dst}$	$c \in C$	market equilibrium for composite commodity (S=D)
29	$\bar{q}_f^f \quad \sum_{a \in APRD} q_{fa}^f$	$f \in FAFE$ $f \neq lw$	market equilibrium for fully employed aggregate factors (S=D)
30	$\bar{q}_f^f \geq \sum_{a \in APRD} q_{fa}^f \qquad \left[w_f \geq \bar{w}_f^{\min} \right]$	$f \in FAUN$ $f \neq lw$	market equilibrium for potentially unemployed aggregate factors (S≥D)
31	$\bar{q}_f^f \geq \sum_{a \in AFAG} q_{fa}^f \qquad \left[w_f \geq 0 \right]$	$f \in FD$	market equilibrium for disaggregated factors (S≥D)
32	$\sum_{c \in C} \bar{p}_c^{wm} q_c^m \quad \sum_{z \in Z} \bar{t}_{row,z} \quad \sum_{c \in C} \bar{p}_c^{we} q_c^e \quad \sum_{z \in Z} \bar{t}_{z,row} \quad \bar{f}^{sav}$		current account balance (in foreign currency)
33	$\sum_{h \in H} \theta_h^{sav} (1 \quad \tau_h^d) y_h^h \quad (y^g \quad e^g) \quad r\bar{f}^{sav} \quad \sum_{c \in C} p_c^q (\bar{q}_c^{inv} \quad \bar{q}_c^{dst})$		savings-investment balance
34	$\bar{p}^d \quad \sum_{c \in C} \omega_c^d p_c^d$		price index for domestic output (numéraire)

1. The following notational convention is used: Superscripts are part of variable/parameter names; subscripts are set indices. Variables are written as one or more base-level Latin letters without a bar. Parameters appear as Greek letters or as Latin letters with a bar.
2. CES*, CET*, LES* indicate relationships derived from the respective functions.
3. Complementary constraints are shown in brackets in the equation column. *lw* = the aggregate factor irrigated-land-water, an aggregation of the disaggregated factors *irrigated land* and *water*
4. *row* = rest of the world
5. *gov* = government

Note: The mathematical statement is simplified. The following aspects has been suppressed:
(i) domain controls (limiting equations and variables to subsets of the sets indicated); (ii) wage distortion factors (permitting wage differences across activities); and (iii) special treatments of markets for aggregate factors (permitting rural-urban migration and activity-specificity); (iv) price-responsiveness of selected intermediate input coefficients; (v) disaggregation of imports and exports by source and destination (EU vs. non-EU), respectively; and (vi) constant-elasticity demand curves for selected export commodities-regions in place of fixed export prices. The full model is described in section 3.

Table A.2.1. Household incomes disaggregated by source (1994, in percentages)

	Urban Poor	Urban Non-Poor	Rural Poor	Rural Non-Poor
Agricultural Resources				
Rainfed Land		1.1	28.7	13.9
Pasture-Fallow Land		0.2	4.7	2.3
Irrigated Land and Water		0.4	4.9	5.4
Capital				
Rainfed Agricultural		0.5	13.0	6.3
Irrigated Agricultural		0.2	2.9	3.1
Other Agricultural				3.0
Rural Non-agricultural				17.6
Urban Capital		35.4		
Labor				
Agricultural Unskilled			23.2	13.4
Rural Non-agricultural Unskilled			13.9	8.0
Rural Non-agricultural Skilled				14.4
Urban Unskilled	73.5	6.9		
Urban Skilled	10.6	40.4		
Transfers				
Non-Tariff Barrier Rents		4.4		
Government Transfers	4.2	2.8	2.3	3.3
Rest of the World Transfers	11.7	7.8	6.4	9.2

Table A.2.1. Economic growth and structural change, 1970-1996

	Real Growth (% per year)			Share of GDP (%)		
	1970-80	1980-90	1990-96	1970	1980	1996
GNP per capita	2.9	1.5	1.0			
GDP at market prices	5.6	3.8	2.7	100.0	100.0	100.0
Agriculture	2.2	3.8	2.8	19.9	18.4	20.4
Industry	5.9	3.2	2.1	27.0	30.9	30.5
Services	6.8	4.2	3.0	53.1	50.6	49.1
Domestic Absorption	6.2	3.4	3.0	103.9	110.5	104.8
Private Consumption	5.4	3.1	4.4	73.4	68.0	67.8
Government Consumption	10.9	4.7	0.1	12.0	18.3	16.4
Gross Investment	7.0	3.4	0.3	18.5	24.2	20.6
Fixed Investment	7.2	3.7	0.9	14.9	22.2	20.4
Resource gap				-3.9	-10.5	-4.8
Exports of Goods & Services	3.4	6.7	3.4	17.6	17.4	25.1
Imports of Goods & Services	6.3	4.6	3.1	21.6	27.9	29.9
Openness (Trade/GDP)				39.2	45.3	55.0

Notes: * Real growth computed at 1987 prices.
** Share data computed at current prices.

Source: WDI 1997, RMSM, December 1997.

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